

B.Sc BIOCHEMISTRY

(For the students admitted from 2023–2024 onwards)



DEPARTMENT OF BIOCHEMISTRY

RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)

Accredited at 'A' Grade by NAAC & DST-FIST Sponsored College

Thanjavur - 613 005, Tamil Nadu, India

**TANSICHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM
FRAMEWORK FOR UNDERGRADUATE EDUCATION**

Programme:	B.Sc Biochemistry
Programme Code:	
Duration:	3 years [UG]
Programme Outcomes:	<p>PO1: Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study</p> <p>PO2: Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.</p> <p>PO3: Critical thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.</p> <p>PO4: Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one’s learning to real life situations.</p> <p>PO5: Analytical reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.</p> <p>PO6: Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation</p> <p>PO7: Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team</p> <p>PO8: Scientific reasoning: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned</p>

	<p>perspective.</p> <p>PO9: Reflective thinking: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.</p> <p>PO10 Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.</p> <p>PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.</p> <p>PO 12 Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.</p> <p>PO 13: Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values in conducting one’s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one’s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.</p> <p>PO 14: Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.</p> <p>PO 15: Lifelong learning: Ability to acquire knowledge and skills, including „learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.</p>
<p>Programme Specific Outcomes:</p>	<p>PSO1 – Placement: To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.</p> <p>PSO 2 - Entrepreneur: To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations</p> <p>PSO3 – Research and Development: Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.</p>

	<p>PSO4 – Contribution to Business World: To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p>PSO 5 – Contribution to the Society: To contribute to the development of the society by collaborating with stakeholders for mutual benefit</p>
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PROGRAM OUTCOMES

PO1	Acquire knowledge in Biochemistry and apply the knowledge in their day to day life for betterment of self and society
PO2	Develop critical ,analytical thinking and problem solving skills
PO3	Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret and draw conclusion from data
PO4	Address and develop solutions for societal and environmental needs of local, regional and national development
PO5	Work independently and engage in lifelong learning and enduring proficient progress
PO6	Provoke employability and entrepreneurship among students along with ethics and communication skills

PROGRAM SPECIFIC OUTCOMES

PSO1	Comprehend the knowledge in the biochemical, analytical, biostatistical and computational areas
PSO2	Ability to understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by human kind
PSO3	Acquiring analytical and hands on skills to perform research in multidisciplinary environments
PSO4	Use library search tools and online databases and sources to locate and retrieve scientific information about a topic and techniques related to biochemistry

Eligibility for admission

Candidate for admission to the first year of B.Sc. Degree Course in Bio-Chemistry shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry.

3. Highlights of the Revamped Curriculum

- The curriculum is created to improve the relationship between business and academia
- Every semester, practicals based on the course taken that semester will aid students in applying what they have learned
- Students will benefit from the introduction of skill based elective courses including Bioinformatics, Nanobiotechnology, Therapeutic nutrition, and Medical Laboratory technology as they keep up with technological advancements in their fields of study
- The fourth semester internship will give students a chance to apply what they have learned in class to a real world working experiment
- Skill enhancement courses help students venture new platforms in career.
- Equip students with employability skills, generate self employment and small scale entrepreneurs.

4. Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	Foundation Course It depicts the overview of entry education and makes the students assimilate with the biochemistry course. This course will inculcate knowledge of the academic skills, laboratory skills and research	It gives a strong determination to undergo the course. Be committed and interested in learning the subject
I, II, III, IV	Skill Enhancement papers (Discipline centric / Generic / Entrepreneurial)	<p>Improve employability Develop the skill as Laboratory Analyst To make students compete with industrial expectations.</p> <p>Incorporating the interest on health, diet, lifestyle diseases will enable the students gain knowledge to get exposed themselves in medical field</p>

		<p>Biomedical Instrumentation skills will aid the students gain knowledge on the various instruments used in the field of medical laboratory and research.</p> <p>Entrepreneurial skill training will increase the chance to build their career independently. Learning this skills will encourage the students to enhance creativity, innovation and collaboration</p> <p>Discipline /subject specific skill will serve as a route for employability</p>
V & VI	<p>Elective papers- An open choice of topics categorized under Generic and Discipline Centric</p>	<p>It reinforces additional knowledge inputs along with core course. Students are familiarized with multi-disciplinary, crossdisciplinary and inter disciplinary subjects.</p> <p>It broadens the knowledge on immunological aspects, pharmacology and research.</p> <p>Additional Employability skills are facilitated through computational biology and Bioentrepreneurship.</p>
V semester Vacation activity	<p>Internship/ Industrial visit/Field visit</p>	<p>Hand on training in Medical Labs/ Industry/ Research centres enable the students to explore the practical aspects in career path. They gain confident to fix their career.</p>
VI Semester	<p>Project with Viva – voce</p>	<p>Self-learning is enhanced. It serves as a platform to express their innovative ideas in a practical way, which serves as a pathway to enter in the field of research.</p>
VI Semester	<p>Introduction of Professional Competency skill</p>	<p>The revamped curriculum caters the education to all category of learners; Learning multidisciplinary papers, updated in the curriculum will help the students to fix their career in the fields of Medical, pharmaceutical, forensic, nutritional, diagnostic coding ,etc</p> <p>·Students are trained in the field of research to bring out the progress in the field of Medical, Agriculture ,Nutrition ,etc which will be a back bone for health and wealth creation and improve the quality of life</p>

Extra Credits: For Advanced Learners / Honours degree	ETo cater to the needs of peer learners / research aspirants
Skills acquired from the Courses	Analytical, Laboratory operating, Predicting, Experimenting, Critical thinking, Problem solving, Communication, Interpersonal, Time management and Multi-tasking Skills

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective -VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement -(Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	30		23	30		22	30		25	30		26	30		21	30
Total – 140 Credits																	

RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)

Thanjavur-5

Illustration for B.Sc.Biochemistry

Curriculum Design

First Year Semester-I

Part	Course	Subject Code	List of Courses	Credit	Hours per week (L/T/P)	Exam Hours	Marks		Total
							Int.	Ext.	
I	LT1	T1T1	Tamil - I	3	6	3	25	75	100
II	LE1	T1E1	English - I	3	6	3	25	75	100
III	CC1	T1BC1	Core Course – I : Biomolecules	5	5	3	25	75	100
III	CC2	T1BC2	Core Course – II(Practical): Analysis of Biomolecules	3	3	3	25	75	100
III	EC1	T1GCH1	General Chemistry-I	3	4	3	25	75	100
III	EC2	T2GCH2	General Chemistry - Practical	-	2	-	-	-	-
IV	SEC1	T1BCSE1	Biomedical Instrumentation	2	2	3	25	75	100
IV	FC	BCFC	Basics of Biochemistry	2	2	3	25	75	100
Total				21	30				700

Semester-II

Part	Course	Subject Code	List of Courses	Credit	Hours per week (L/T/P)	Exam Hours	Marks		Total
							Int.	Ext.	
I	LT2	T2T2	Tamil -II	3	6	3	25	75	100
II	LE2	T2E2	English -II	3	6	3	25	75	100
III	CC3	T2BC3	Core Course – III: Biochemical techniques	5	5	3	25	75	100
III	CC4	T2BC4	Core Course – IV (Practical): Biochemical techniques	3	3	3	25	75	100
III	EC3	T2GCH2	General Chemistry-II (Practical)	3	2	3	25	75	100
III	EC4	T2GCH3	General Chemistry-II	4	4	3	25	75	100
IV	SEC2	T2BCSE2	First Aid	2	2	3	25	75	100
IV	SEC3	T2BCSE3	Basics of Forensic Science	2	2	3	25	75	100
Total				25	30				800

Second Year Semester-III

Part	Course	Subject Code	List of Courses	Credit	Hours per week (L/T/P)	Exam Hours	Marks		Total
							Int.	Ext.	
I	LT3	T3T3	Tamil - III	3	6	3	25	75	100
II	LE3	T3E3	English–III	3	6	3	25	75	100
III	CC5	T3BC5	Core Course – V: Nutritional Biochemistry	5	5	3	25	75	100
III	CC6	T3BC6	Core Course – VI (Practical): Food and Nutritional Analysis	3	3	3	25	75	100
III	EC4	TG4	General Microbiology I	3	4	3	25	75	100
III	EC5	TG5	General Microbiology Practical	-	2	-	-	-	-
IV	SEC4	T3BCSE4	Medical Laboratory Technology	1	1	3	25	75	100
IV	SEC5	T3BCSE5	Tissue Culture	2	2	3	25	75	100
IV	EVS	T4ES	Environmental Studies	-	1	-	-	-	-
Total				20	30				700

Semester-IV

Part	Course	Subject Code	List of Courses	Credit	Hours per week (L/T/P)	Exam Hours	Marks		Total
							Int.	Ext.	
I	LT4	T4T4	Tamil - IV	3	6	3	25	75	100
II	LE4	T4E4	English - IV	3	6	3	25	75	100
III	CC7	T4BC7	Core Course – VII: Enzymology	4	4	3	25	75	100
III	CC8	T4BC8	Core Course – VIII (Practical) : Enzymes	3	3	3	25	75	100
III	EC5	TG5	General Microbiology Practical	3	2	3	25	75	100
III	EC6	TG6	General Microbiology II	4	4	3	25	75	100
IV	SEC6	T4BCSE6	Medical Coding	2	2	3	25	75	100
IV	SEC7	T4BCSE7	Microbial Techniques	2	2	3	25	75	100
IV	EVS	T4ES	Environmental Studies	2	1	3	25	75	100
Total				26	30				900

Third Year Semester-V

Part	Course	Subject Code	List of Courses	Credit	Hours per week (L/T/P)	Exam Hours	Marks		Total
							Int.	Ext.	
III	CC9	T5BC9	Core Course – IX: Cell Biology	4	6	3	25	75	100
III	CC10	T5BC10	Core Course – X: Intermediary metabolism	4	6	3	25	75	100
III	CC11	T5BC11	Core Course – XI : Molecular Biology	4	5	3	25	75	100
III	CC12	T5BC12	Core Course – XII(Practical): Cell Biology Practical	3	3	3	25	75	100
III	EC7	TBCECA	Biochemical pharmacology	3	4	3	25	75	100
III	EC8	TBCECB	Biotechnology	3	4	3	25	75	100
IV	VE	T5VE	Value Education	2	2	2	25	75	100
IV			Internship / Industrial Training	2	-	-	-	-	-
Total				25	30				700

Semester-VI

Part	Course	Subject Code	List of Courses	Credit	Hours per week (L/T/P)	Exam Hours	Marks		Total
							Int.	Ext.	
III	CC13	T6BC13	Core Course – XIII: Clinical Biochemistry	5	6	3	25	75	100
III	CC14	T6BC14	Core Course – XIV: Human Physiology	5	6	3	25	75	100
III	CC15	T6BC15	Core Course – XV(Practical): Clinical analysis	4	4	3	25	75	100
III	EC9	TBCECC	Immunology	3	6	3	25	75	100
III	EC10	TBCECD	Research methodology	3	6	3	25	75	100
IV	PCS	T6BCPC	Professional Competency Skill	2	2	2	25	75	100
V			Extension Activity	1	-	-	-	-	-
Total				23	30				600

Total Credits: 140

**** Internship will be carried out during the summer vacation of the Second year and marks will be included in the Fifth Semester Marks Statement.**

RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS), THANJAVUR -613005

B.Sc., BIO CHEMISTRY COURSE STRUCTURE

(for the candidates admitted from the academic year **2023-2024** onwards)

List of Elective courses

Part -A (Generic)

S.No	Course Code	Title of the Course
1	T1GCH1	General Chemistry –I
2	T2GCH2	General Chemistry - Practical
3	T2GCH3	General Chemistry- II
4	T3GBO1	Botany – I
5	T4GBO2	Botany - Practical
6	T4GBO3	Botany –II
7	TG4	General Microbiology - I
8	TG5	General Microbiology – Practical
9	TG6	General Microbiology - II

Part -B (Discipline)

S.No	Course Code	Title of the Course
1	TBCECA	Biochemical Pharmacology
2	TBCECB	Biotechnology
3	TBCECC	Immunology
4	TBCECD	Research Methodology
5	TBCECE	Public HealthandHygiene
6	TBCECF	Pharmaceutical Biotechnology
7	TBCECG	Mushroom Cultivation and Value Addition
8	TBCECH	Personal Hygiene
9	TBCECI	Food Processing
10	TBCECJ	Hospital Management
11	TBCECK	Biofertilizer
12	TBCECL	Apiculture

SKILL ENHANCEMENT COURSE

- 1. Biomedical Instrumentation**
- 2. Medical Coding**
- 3. Microbial Techniques**
- 4. Medical Laboratory Technology**
- 5. Tissue Culture**
- 6. First Aid**
- 7. Basics of Forensic Science**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	11	15	11	14	21	20	93
Part IV	4	4	3	6	4	2	22
Part V	-	-	-	-	-	1	1
Total	21	25	20	26	25	23	140

***Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

FIRST YEAR : SEMESTER I

BIOMOLECULES SUBJECT CODE :T1BC1

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC I	Core paper 1: Biomolecules	Core	2	1	-	-	5	5	25	75	100

Learning objectives

The main objectives of this course are to:

- Introduce the structure, properties and biological significance of carbohydrates
- Comprehend the classification, functions and acid base properties of amino acids
- Elucidate the various levels of organization of Proteins.
- Impart knowledge on the classification, properties and characterization of lipids.
- Acquaint with the classification, structure, properties and functions of nucleic acids

Module I: Carbohydrates-Classification and biological significance, physical properties - stereo isomerism, optical isomerism, anomers, epimers and mutarotation. Monosaccharides: Occurrence, properties and its biological roles, linear and cyclic structures. Disaccharides: Structure and properties of reducing disaccharides (lactose and mannose), non-reducing disaccharide(sucrose). Polysaccharides: Homopolysaccharides - Occurrence, structure and biological significance of starch and glycogen. Heteropolysaccharides - Structure and biological significance of mucopolysaccharides - hyaluronic acid, chondroitin sulphate and heparin. (structural elucidation not needed). 12 hrs

Module II : Amino acids -Classification based on composition of side chain and nutritional significance. General structure of amino acids. Physical properties of amino acids, isoelectric point, titration curve (alanine, lysine, glutamic acid), optical activity. Chemical reactions due to carboxyl group, amino group and side chains. Colour reactions of amino acids. 12Hrs

Module III : Proteins-Classification based on shape, composition, solubility and functions. Properties of proteins - Ampholytes, isoelectric point, salting in and salting out, denaturation and renaturation. Levels of Organization of protein structure- Primary structure, Formation and characteristics of peptide bond, Secondary structure- α helix, β -pleated sheath and triple helix. Tertiary structure – with reference to myoglobin. Quaternary structure with reference to haemoglobin. 12 Hrs

Module IV : Lipids- Lipids: Bloor's classification, chemical nature and biological functions. Fatty acids: classification, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides: structure and general properties, Characterization of fats- iodine value, saponification value, acid number, acetyl number, Reichert –Meissl number along with their significance. Compound lipids- Structure and functions of phospholipids and glycolipids. Derived lipids- Structure and functions of cholesterol. 12Hrs

Module V : Nucleic acids-Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA: A, B, C, Z DNA, structure and biological significance, superhelicity. Types of RNA: mRNA, tRNA, rRNA, hnRNA, snRNA ,Secondary and tertiary structure of tRNA. Properties of DNA-Hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing.12Hrs

CO	On completion of this course, students will be able to	Program outcomes
CO1	Classify, illustrate the structure and explain the physical and chemical properties of carbohydrates.	PO1
CO2	Indicate the classification, structure, properties and biological functions of amino acids.	PO1
CO3	Explain the classification and elucidate the different levels of structural organization of proteins.	PO1
CO4	Elaborate on classification, structure, properties, functions and characterization of lipids	PO1,PO4
CO5	Describe the structure, properties and functions of different types of nucleic acids	PO1

Course Outcomes

Textbooks

- 1.Biochemistry,U.Sathyannarayana&U.Chakrapani,2013,5thedition Elsevier India Pvt. Ltd., Books & Allied Pvt. Ltd.
- 2.Fundamentals of Biochemistry, J.L.Jain, Sunjay Jain, Nitin Jain, 2013, 7thedition S.Chand & Company Ltd.
- 3.Textbook of Medical Biochemistry, MNChatterjea, RanaShinde, 2002, 8thedition, Jaypee Brothers.

Referencebooks

- 1.David L. Nelson, Michael M.Cox, 2005, Principles of Biochemistry, 4thedition W.H.Freeman and Company.
- 2.Voet.D, Voet.J.G. and Pratt, C.W, 2004, Principles of Biochemistry, 4thedition John Wiley & Sons,Inc.
- 3.Zubay G.L, *et.al.*, 1995, Principles of Biochemistry, 1stedition, WmC. Brown

Publishers.

Webresources

<https://www.britannica.com/science/biomolecule>
<https://en.wikipedia.org/wiki/Biomolecule>
<https://www.khanacademy.org/science/biology/macromolecules>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3			2			3	2		3
CO5	3						3			3

S-Strong(3) M-Medium (2) L-Low

FIRST YEAR :SEMESTER I
SUBJECT CODE :T1BC2
PRACTICAL I
ANALYSIS OF BIOMOLECULES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC II	Core Course – II(Practical): Analysis of Biomolecules	Core Practical	-	-	3	-	3	3	25	75	100

Learning Objectives

The main objectives of this course are to

- Identify the biomolecules carbohydrates and amino acids by qualitative test
- Determine the quality of Lipids by titrimetric methods
- Isolate nucleic acids from plant and animal source

I)Qualitative test for 15 Hrs

1) Carbohydrates

a) Glucose b) Fructose c) Maltose d) Sucrose e) Lactose f)Starch

2) Amino acids

a) Arginine b) Proline c) Tryptophan d) Tyrosine

II Titrimetric methods15 Hrs

1) Determination of Saponification value of an edible oil

2) Determination of Iodine number of an edible oil

3) Determination of Acid number of an edible oil

III. Group Experiments 15 hrs

1) Isolation of DNA from plant/animal source.

2) Isolation of RNA from rich source.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Qualitatively analyze the carbohydrates and report the type of carbohydrate based on specific tests	PO1,PO2,PO3
CO2	Qualitatively analyze amino acids and report the type of amino acids based on specific tests	PO1,PO2,PO3
CO3	Determine the Saponification, Iodine and acid number of edible oil	PO1, PO3,PO4
CO4	Isolate the nucleic acid from biological sources	PO1,PO3

Text books

1. David T Plummer, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw-Hill Edition
2. J. Jayaraman Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015
3. S. Sadasivam A. Manickam Biochemical Methods New age International Pvt Ltd publisher's third edition 2018

Reference books

1. Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees A Practical book on Biochemistry Everest publishing house 1st Edition, 2019
2. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.
3. Biochemical Tests – Principles and Protocols. Anil Kumar, Sarika Garg and Neha Garg. Vinod Vasishtha Viva Books Pvt Ltd, 2012.
4. Harold Varley, Practical Clinical Biochemistry, CBS. 6 edition, 2006.
5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain. 1995.

Web resources

1. <https://www.pdfdrive.com/instant-notes-analytical-chemistry-e912659.html> 14
2. <https://www.pdfdrive.com/analytical-biochemistry-e46164604.html>
3. <https://www.pdfdrive.com/biochemistry-books.html>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3	3				3	3	3	3
3CO 2	2	3	3				3	3	3	3
CO 3	2		3	2			3	3	3	3
CO 4	2		3				3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

SKILL ENHANCEMENT COURSE -SEC

BIOMEDICAL INSTRUMENTATION

SUBJECT CODE :T1BCSE1

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC1	Biomedical Instrumentation	SEC(Discipline)	2	-	-	-	2	2	25	75	100

Learning Objectives

The objectives of this course are to

- Provide insights about the blood pressure and its measurement.
- Elaborate the mechanism of instruments related to respiration.
- Highlight the importance of imaging techniques.
- Acquaint students about the basics of medical assisting devices.
- Familiarize about the life saving therapeutic equipments.

Module I: Measurement of blood pressure – sphygmomanometer. Cardiac output – Cardiac rate – Heart sound – Stethoscope, ECG – EEG – EMG – ERG. 6 Hrs

Module II: Monitoring of inspired/expired anaesthetic gases, capnograph, inhalators, nebulizers, aspirators, infant respirator, Plethysmography. 6 Hrs

Module III: Medical imaging: X-ray machine - Radio graphic and fluoroscopic techniques – Computed tomography – MRI – PET, Ultrasonography – Endoscopy – Thermography. 6 Hrs

Module IV: Assisting equipments: Pacemakers – Defibrillators – Ventilators 6 Hrs

Module V: Therapeutic equipments: Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers. 6 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Illustrate the functions of instruments used for measuring blood pressure.	PO1, PO2, PO5
CO2	Elaborate the devices required for monitoring of respiratory gases.	PO1, PO2, PO5

CO3	Understand the operation of the imaging and sonographic instruments.	PO1,PO2, PO5
CO4	Differentiate between the action of pacemakers , defibrillators and ventilators.	PO1,PO2, PO5
CO5	Demonstrate the function of therapeutic equipments	PO1,PO2, PO5

Text books

1. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies.
2. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’, John Wiley & Sons.
3. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons.
4. C.Rajarao and S.K.Guha, ‘Principles of Medical Electronics and Bio-medicalInstrumentation’, Universities (India) Ltd, Orient Longman Ltd.

Reference books

1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, ‘Bio-Medical Instrumentation and Measurements’, II Edition, Pearson Education, 2002.
2. R.S.Khandpur, ‘Handbook of Bio-Medical instrumentation’, Tata McGraw Hill Publishing Co Ltd.,

WebResources

<https://youtu.be/GkUCmb0cKwo?list=PLCZ9KmODEcu138IIVeHClJ4nskArYr1Dg>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3			3		3	3	3	3
CO 2	2	3			3		3	3	3	3
CO 3	2	3			3		3	3	3	3
CO 4	2	3			3		3	3	3	3
CO 5	2	3			3		3	3	3	3

S-Strong(3) M-Medium (2) L-Low

FOUNDATION COURSE

BASICS OF BIOCHEMISTRY

SUBJECT CODE :BCFC

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
FC	Basics of Biochemistry	Foundation Course	2	-	-	-	2	2	25	75	100

BASICS OF BIOCHEMISTRY

Unit 1: Cellular and chemical foundations of life - chemical molecules of life - complex biomolecules - chemical composition of man - prokaryotic and eukaryotic cells - integration of Cellular functions

Unit 2: Water and life- Distribution of water- Water turnover and balance- Electrolyte balance- Osmolarity and osmolality of body fluids-Blood buffers

Unit 3 Body fluids- milk-Cerebrospinal fluid (CSF)-Amniotic fluid-Pleural fluid-Aqueous humor - Composition and functions

Unit 4: Vitamins- structure and active forms of water soluble and fat soluble vitamins; deficiency diseases and symptoms, hypervitaminosis

Unit 5: Mineral metabolism - General functions – classification – Macrominerals(Calcium, Phosphorus, magnesium, sodium, potassium) - Microminerals (Iron, copper, manganese, zinc, and selenium) - Major functions -deficiency - major sources-Disease/symptoms.

FIRST YEAR :SEMESTER II

CORE COURSE – III: BIOCHEMICAL TECHNIQUES

SUBJECT CODE:T2BC3

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC III	Core Course – III: BIOCHEMICAL TECHNIQUES	Core	2	3	-	-	5	5	25	75	100

Learning objectives

The objectives of this course are to

- Introduce the basic principles, types and applications of various sedimentation technique.
- Provide an understanding of the underlying principles of chromatographic techniques
- Demonstrate experimental skills in various electrophoretic techniques.
- Appraise the use of colorimetric and spectroscopic techniques in biology
- Impart knowledge about the measurement of radioactivity and safety aspects of radioactive isotopes.

Module I: Centrifugation - Basic principles, RCF, Sedimentation coefficient, Svedberg constant. Types of rotors. Preparative centrifugation- differential and density gradient centrifugation, Rate zonal and Isopycnic techniques, construction, working and applications of analytical ultracentrifuge. 9 Hrs

Module II: Chromatography - adsorption, partition. Principle, instrumentation and applications of paper chromatography, thin layer chromatography, ion-exchange chromatography, gel permeation chromatography and affinity chromatography. 9 Hrs

Module III: Electrophoresis – General principles, factors affecting electrophoretic mobility. Tiselius moving boundary electrophoresis. Electrophoresis with paper and starch. Principle, instrumentation and applications of agarose gel electrophoresis and SDS-PAGE. 9Hrs

Module IV: Absorption and emission spectra, Lambert – Beer Law, Light absorption and transmittance. Colorimetry - Principle, instrumentation and applications. Visible and UV spectrophotometry – Principle, instrumentation and applications -enzyme assay, structural studies of proteins and nucleic acids. 9 hrs

Module V: Radioactivity - Types of Radioactive decay, half-life, units of radioactivity, Detection and measurement of radioactivity - Methods based upon ionization -Geiger Muller Counter. Methods based upon excitation - Solid & Liquid scintillation counters. Autoradiography. Biological applications and safety aspects of radioisotopes.9 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Describe types of rotors and identify the centrifugation technique for the separation of biomolecules.	PO1,PO2,PO6
CO2	Demonstrate the principles, operational procedure and applications of planar and column chromatography.	PO1,PO2, PO6
CO3	Specify the factors and explain the separation of DNA and protein using electrophoretic technique.	PO1,PO2, PO6
CO4	State Beer's Law and illustrate the instrumentation and uses of colorimeter and spectrophotometer .	PO1,PO2, PO6
CO5	Enumerate various methods of measurement of radioactivity and safety aspects of radioactive isotopes.	PO1,PO2, PO6

Textbooks

1.AvinashUpadhyay, Kakoli Upadhyay & Nirmalendu Nath, 2002, Biophysical Chemistry, Principles and Techniques, 3rd edition, Himalaya Publishing House.

2.L.Veerakumari, 2009, Bioinstrumentation, 1stedition, MJP Publishers.

3. Keith Wilson & John Walker, 2000, Practical Biochemistry-Principles and techniques,

Cambridge University Press, 4thedition.

Reference books

1.Terrance G. Cooper The tools of Biochemistry ,. 1977, , John Wiley & Sons, Singapore.

2.Gurumani, ResearchMethodology for Biological Sciences, 2011, 1stedition, MJPPublishers.

3. SarojDua, Neera Garg, Biochemical Methods of Analysis, 2010, 1stedition,Narosa Publishing house.

Web Resources

1.<https://www.britannica.com/science/chromatography>

2.<https://www.youtube.com/watch?v=xgxFBQZYXIE>

3.<https://www.youtube.com/watch?v=7onjVBsQwQ8>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3				2	3	3	3	3
CO 2	2	3				2	3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO 5	2	3				2	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

FIRST YEAR :SEMESTER II

CORE COURSE – IV PRACTICAL II BIOCHEMICAL TECHNIQUES

SUBJECT CODE:T2BC4

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC4	Core Course IV-Practical II-Biochemical techniques	Core Practical	-	-	3	-	3	3	25	75	100

Learning objectives

The objectives of this course are to:

- Acquaint the students with colorimetric estimations of biomolecules.
- Equip skills on various separation techniques.
- Impart knowledge about the estimation of minerals and vitamins.

I Colorimetry

1. Estimation of amino acid by Ninhydrin method.
2. Estimation of protein by Biuret method.
3. Estimation of DNA by Diphenylamine method.
4. Estimation of RNA by Orcinol method.
5. Estimation of Phosphorus by Fiske and Subbarow method.

II Chromatography

1. Separation and identification of sugars and amino acids by paper chromatography.
2. Separation and identification of amino acids and lipids by thin layer chromatography.

III Demonstration

1. Separation of serum and plasma from blood by centrifugation.
2. Separation of serum proteins by SDS-PAGE.

Course Outcomes

CO	On completion of this course, students will be able to	Programoutco
CO1	Estimate the amount of biomolecules by Colorimetric method.	PO1,PO3,PO6
CO2	Quantify the amount of minerals by Colorimetric method	PO1,PO3,PO6
CO3	Separate and identify sugars, lipids and amino acids by chromatography	PO1,PO3
CO4	Operate centrifuge for the separation of serum and plasma	PO1,PO3,PO6
CO5	Demonstrate the separation of proteins electrophoretically	PO1,PO3,PO6

Text books

1. J. Jayaraman, Laboratory Manual in Biochemistry New Age International (P) Limited Fifth edition 2015.
2. S.Sadasivam A.Manickam Biochemical Methods New age International Pvt Ltd. publishers third edition 2018.
- 3.Keith Wilson and John Walker Principles and techniques of Practical Biochemistry Cambridge University Press 2010, Seventh edition.

Reference books

1. S. K. Sawhney andRandhir Singh, Introductory Practical Biochemistry. Alpha Science International, Ltd 2nd edition, 2005.
- 2.David T. Plummer, 2001, An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw- Hill publishing company limited.
3. Varley's Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition,1988.

Web resources

<https://www.pdfdrive.com/biochemistry-books.html>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2		3			2	3	3	3	3
CO 2	2		3			2	3	3	3	3
CO 3	2		3				3	3	3	3
CO 4	2		3			2	3	3	3	3
CO 5	2		3			2	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

FIRST YEAR :SEMESTER II

FIRST AID

SUBJECT CODE:T2BCSE2

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC2	First Aid	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to:

- Provide knowledge on the basics of first aid.
- Perform first aid during various respiratory issues.
- Demonstrate the first aid to treat injuries.
- Learn the first aid techniques to be given during emergency.
- Familiarize the first aid during poisoning.

Module I: Aims and important rules of first aid, dealing with emergency, types and content of a first aid kit. First aid technique – Dressing and Bandages, fast evacuation technique, transport techniques.6 Hrs

Module II: Basics of Respiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma. 6 Hrs

Module III: Common medical aid- first aid for wounds, cuts, head, chest, abdominal injuries, shocks, burns, amputations, fractures, dislocation of bones. 6Hrs

Module IV: First aid related to unconsciousness, stroke, fits, convulsions- seizures, epilepsy 6Hrs

Module V: First aid in poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant, acid and alkali poisoning .6Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program
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		outcomes
CO1	Discuss on the rules of first aid, dealing during emergency and first aid techniques	PO1.PO4,PO5
CO2	Understand the first aid techniques to be given during different types of respiratory problems	PO1.PO4,PO5
CO3	Provide first aid for injuries, shocks and bone injury	PO1.PO4,PO5
CO4	Detail on the first aid to be given for unconsciousness, stroke, fits and convulsions	PO1.PO4,PO5
CO5	Gain expertise in giving first aid for insect bites and chemical poisoning	PO1.PO4,PO5

Text books

- 1) First aid and health Dr. Gauri Goel, Dr. Kumkum Rajput, Dr.ManjulMungali
1ISBN-978-93-92208-19-5
- 2) Indian First Aid Manual-<https://www.indianredcross.org/publications/FA-manual.pdf>
- 3) Red Cross First Aid/CPR/AED Instructor Manual

Reference books

Web resources

- 1)<https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online>
- 2)<https://www.firstaidforfree.com/>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2						3	3	3	3
CO 2	2			3	3		3	3	3	3
CO 3	2			3	3		3	3	3	3
CO 4	2			3	3		3	3	3	3
CO5	2			3	3		3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

FIRST YEAR :SEMESTER II
BASICS OF FORENSIC SCIENCE
SUBJECT CODE:T2BCSE3

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC3	Basics of Forensic Science	SEC (Discipline)	1	1	-	-	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

C1 Gain knowledge on the basic practices of forensic analysis.

C 2 Perform investigation using fresh blood.

C 3 Carry out the analysis using body fluids

C 4 Investigate the presence of forms of drugs and poisons in body fluids.

C5 Execute the identification test on multiple samples.

Module I: Forensic Science: Definition, History and Development. Crime scene management and investigation; collection, preservation, packing and forwarding of physical and trace evidences for analysis. 6Hrs

Module II: Blood – grouping and typing of fresh blood samples including enzyme .Cases of disputed paternity and maternity problems, DNA profiling.6Hrs

Module III: Analysis of body fluids- Analysis of illicit liquor including methyl and ethyl alcohol in body fluids and breathe. Chemical examination, physiology and pharmacology of Insecticides and pesticides. 6Hrs

Module IV: Psychotropic drugs -Sedatives, stimulants, opiates and drugs of abuse. Identification of poisons from viscera, tissues and body fluids. 6Hrs

Module V: Identification tests- Identification of hair, determination of species origin, sex, site and individual identification from hair. Classification and identification of fibers. Examination and identification of saliva, milk, urine and faecal matter 6Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Gain knowledge on basics of forensic science and method for collection and preservation of samples	PO1,PO2,PO6
6CO2	Assess the paternity ,maternity problems and DNA profiling	PO1,PO2
CO3	Identify the presence of alcohol ,insecticides and pesticides in body fluids	PO1,PO2
CO4	Detail on the test performed to identify the presence of drugs and poisons in body fluids	PO1,PO2
CO5	Identify species and sex from the available body fluids	PO1,PO2

Reference books

1. An Introduction to Forensic DNA Analysis by Norah Rudin & Keith Inman USA, Second edition.
2. Forensic Science Handbook, Volume 2 & 3 by Saferstein, Richard E.
4. Forensics by Embar-Seddon, Ayn and Pass. Allan D.
5. Forensic Medicine by Adelman, Howard C &Kobilinsky, Lawrence Page 24 of 63

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3		3	3
CO 2	2	3					3		3	3
CO 3	2	3					3		3	3
CO 4	2	3					3		3	3
CO5	2	3					3		3	3

S-Strong (3) M-Medium (2) L-Low (1)

II YEAR :SEMESTER III

CORE COURSE – V: NUTRITIONAL BIOCHEMISTRY

SUBJECT CODE:T3BC5

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
CC5	Core Course – V: Nutritional Biochemistry	Core	2	1	0	0	5	5	25	75	100

Learning Objectives:

The objectives of this course are to

- Create awareness about the role of nutrients in maintaining proper health
- Understand the nutritional significance of carbohydrates, lipids and proteins.
- Understand the importance of a balanced diet.
- Study the effect of additives, emulsifiers, flavour enhancing substances in food.
- Study the significance of nutraceuticals.

Module I : Concepts of food and nutrition. Basic food groups-energy yielding, body building and functional foods. Modules of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR)- definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA-definition and determination- Anthropometric measurement and indices – Height, Weight, chest and waist circumference BMI.

12 Hrs

Module II: Physiological role and nutritional significance of carbohydrates, lipids and protein. Evaluation of proteins by nitrogen balance method- Biological value of proteins- Digestibility coefficient, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition – Kwashiorkar and Marasmus, Obesity-Types and preventive measures.12 Hrs

Module III : Balanced diet, example of low and high cost balanced diet- for infants, children, adolescents, adults and elderly people. ICMR classification of five food groups and its significance food pyramid. Junk foods- definition and its adverse effects .12 Hrs

Module IV : Food additives: function and application of preservatives, emulsifying agents, buffering agents, stabilizing agents, natural and artificial sweeteners, bleaching, starch modifiers, antimicrobials, food emulsions, fat replacers, viscosity agents, gelling agents and maturing agents. Food colors, flavors, anti-caking agent, antioxidants. Safety assessment of food additives.12 Hrs

Module V : Nutraceuticals and Functional Foods: Definition, properties and function of Nutraceuticals, food Supplements, dietary supplements prebiotics and probiotics, and functional Foods. Food as medicine. Natural pigments from plants– carotenoids, anthocyanins and its benefits. 12 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value	PO1,PO5
CO2	Identify and explain nutrients in foods and the specific functions in maintaining health.	PO1
CO3	Classify the food groups and its significance	PO1,PO2
CO4	Understand the effect of food additives	PO1,PO2
CO5	Describe the importance of nutraceuticals and pigments	PO1,PO5,PO6

Text books

- 1.Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.
- 2.M.Swaminadhan (1995) Principles of Nutrition and Dietics. Bappco.
- 3.Tom Brody(1998). Nutritional Biochemistry (2nded), Academic press, USA
- 4.Garrow, JS,James WPT and Ralph A (2000). Human nutrition and dietetics(10thed) Churchill Livingstone.
- 5.Andreas M.Papas(1998). Antioxidant Status, Diet, Nutrition, and Health (1sted) CRC

Reference Books

- 1.Branen, A.L., Davidson PM &Salminen S. 2001. Food Additives.2nd Ed. Marcel Dekker.
2. Gerorge, A.B. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
- 3.Advances in food biochemistry, FatihYildiz (Editor), CRC Press, Boca Raton, USA, 2010
- 4.Food biochemistry & food processing, Y.H. Hui (Editor), Blackwell Publishing, Oxford, UK, 2006.
- 5.Geoffrey Campbell-Platt. 2009. Food Science and Technology. Wiley-Blackwell ,UK.

Web resources

<http://old.noise.ac.in/SecHmscour/english/LESSON O3.pdf>

<https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein.html>.

<https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3				2		3	3	3	3
CO 2	3						3	3		3
CO 3	3	2					3	1		3
CO 4	3	2					3	3		3
CO5	3				2	2	3	3		3

S-Strong(3)

M-Medium (2)

L-Low (1)

SECOND YEAR : SEMESTER III
CORE COURSE – VI
PRACTICAL III -NUTRITIONAL BIOCHEMISTRY
SUBJECT CODE:T3BC6

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
CC 6	CORE PAPER-VI: Practical III: Nutritional Biochemistry	Core	0	0	3	0	3	3	25	75	100

Learning objectives

The objectives of this course are to

- Impart hands-on training in the estimation of various constituents by titrimetric method
- Prepare Biochemical preparations
- Determine the ash content and extraction of lipid

TITRIMETRY 20hrs

1. Estimation of ascorbic acid in a citrus fruit.
2. Estimation of calcium in milk .
3. Estimation of glucose by Benedict's method in honey.
4. Estimation of phosphorous (Plant source)

BIOCHEMICAL PREPARATIONS 15 Hrs

Preparation of the following substances and its qualitative tests

5. Lecithin from egg yolk.
6. Starch from potato.
7. Casein and Lactalbumin from milk.

GROUP EXPERIMENT 10Hrs

8. Determination of ash content and moisture content in food sample

9. Extraction of lipid by Soxhlet's method.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Estimate the important biochemical constituents in the food samples.	PO1,PO3
CO2	Prepare the macronutrients from the rich sources.	PO1,PO3
CO3	Determine the ash and moisture content of the food samples	PO1,PO3
CO4	Extract oil from its sources	PO1,PO3,PO6

Text books

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, NewAge International Publishers, 2011,

2. An Introduction to Practical Biochemistry, David T. Plummer, 3rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference books

1. Biochemical Methods, Sadasivam S and Manickam A, 4th edition, NewAge International Publishers, 2016

2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.

3. Bowman and Robert M. 2006. Present Knowledge in Nutrition. 9th edition, International Life Sciences Publishers.

4. Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers.

5. Martha H. and Marie A. 2012. Biochemical, Physiological, and Molecular Aspects of Human Nutrition. 3rd edition. Chand Publishers.

Web resources

1. <https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors>

2. <http://rajswashya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf>

3. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

4. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3				3	3	3	3
CO 2	3		3				3	3	3	3
CO 3	3		3				3	3	3	3
CO 4	3		3			3	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

SECOND YEAR : SEMESTER III
MEDICAL LABORATORY TECHNOLOGY
SUBJECT CODE:T3BCSE4

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext ernal	Total
SEC4	Medical Laboratory Technology	SEC (Discipline)	1	1	0	0	2	2	25	75	100

Learning Objectives

The main objectives of this course are to

- Impart knowledge on specimen collection and disposal of waste.
- Acquaint knowledge on collection, preservation and transfusion of blood.
- Quantify the biomolecules in biological sample
- Understand the significance of various tests and their interpretation in diseased conditions
- Acquaint knowledge on enzymes, hormones and Immunoglobulins as markers for diagnosis.

Module I :Collection, transport, analysis of specimen – blood, routine urine, feces, sputum, semen, CSF Documentation of samples & results. Disposal of laboratory/ hospital waste-Non infectious waste , biomedical waste, infected sharp waste disposal, infected non sharp disposal – color coding as per guidelines 6 Hrs

Module II :Determination of Blood group and Rh factor -Basic blood banking procedures- cross matching, screening test. Blood transfusion and hazards.6 Hrs

Module III :Estimation of blood sugar – Enzymatic method,HbA1C, Qualitative and quantitative analysis of urine sample- NPN-urea, uric acid, creatinine. Mineral ,vitamin and CSF analysis.6 Hrs

Module IV :Immuno diagnostics -Widal test, VDRL test, ASO, RA, CRP and Complement fixation Test. RIA, ELISA,, Skin test – Montaux and Lepramin test.6 Hrs

Module V :.Assay of clinically important enzymes- Estimation of clinically important hormones – Insulin, Thyroid and Reproductive hormones and its clinical significance6 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Collect&preserve of biological samples.	PO1,PO2
CO2	Estimate the various constituents in biological sample	PO1,PO2,PO6
CO3	Perform the routine procedures adopted in blood bank	PO1,PO2,PO6
CO4	Analyze and interpret the values for both normal and disease conditions.	PO1,PO2,PO6
CO5	Assay the enzymes and hormones &interpret clinical implications	PO1,PO2,PO6

Text Books

- 1 Kanai L Mukherjee and Anuradha Chakravarthy Medical Laboratory Technology IVthedition, Vol I, 2022
2. Ramnik Sood, Text Book of Medical Laboratory Technology, Jaypee Publishers, 2006
3. Tietz, N. (2018) Fundamentals of Clinical Chemistry and Molecular Diagnostics 8th edition, W.B. Saunders Company

Reference books

Web Resources

- 1 <https://www.youtube.com/watch?v=QNYIX5Ne9IQ>
- 2 <https://www.slideshare.net/doctorrao/agglutination-tests-and-immunoassays>
- 3 <https://microbenotes.com/introduction-to-precipitation-reaction/>

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3				2	3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO5	2	3				2	3	3	3	3

S - Strong (3) M - Medium (2) L -Low(1)

SECOND YEAR : SEMESTER III

TISSUE CULTURE SUBJECT CODE:T3BCSE5

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext erna l	Total
SEC5	Tissue Culture	SEC (Discipline)	1	1	0	0	2	2	25	75	100

Learning Objectives

The objectives of this course are to

- Introduce the tools and techniques used in tissue culture technique.
- Acquire knowledge on preparation of growth medium for culture techniques.
- Impart knowledge on procedures involved gene transfer.
- Acquaint with the process of tissue culture technique.
- Understand the importance of plant and animal tissue culture for the production and evaluation of bioactive compounds

Module I: Introduction to Tissue culture, Types- seed, embryo, Callus, Organ, Protoplast culture, Advantages and importance of tissue culture, Tools and techniques 6 Hrs

Module II : Media and Culture Preparation - pH, temperature, solidifying agents. Role of Micro and macro nutrients. Maintenance of cultures. 6 Hrs

Module III : Methods of gene transfer in plants and animals - direct and indirect gene transfer methods. 6 Hrs

Module IV : Cell culture technique - Explants selection, sterilization and inoculation. 6 Hrs

Module V : Transgenic plants for crop improvement. Transgenic plants for molecular farming. Animal Cloning - an overview-Applications of animal cell culture 6 Hrs

Course outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Introduction to plant tissue culture	PO1,PO2.PO3
CO2	Brief knowledge on preparation of tissue culture media	PO1,PO2

CO3	Understanding on different methods of gene transfer	PO1,PO2,PO3
CO4	Gain knowledge on plant and animal cell culture techniques	PO1,PO2,PO3
CO5	Study of applications of genetically modified plants and animals.	PO1,PO2,PO3

Text books

- 1.Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing corporation.
- 2,Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.
- 3.Lycett, G.W. and Grierson, D. (ed). 1990. Genetic Engineering of crop plants.
- 4.Grierson and Covey, S.N.1988. Plant Molecular biology.Blackie.
- 5.Chawla, H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009.

Reference books

- 1.Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, arias Publications. 1995.
- 2.Stewart Jr., C.N., "Plant Biotechnology and Genetics: Principles, Techniques and Applications" Wiley-Interscience, 2008.
- 3.Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010.6th Edition.
- 4.Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.
- 5.Davis, J. M. (2011).Animal Cell Culture.John Willy and Sons Ltd. USA.
- 6.Freshmen R. I. (2005).Culture of Animal Cells.John Willy and Sons Ltd. USA.
- 6.Butler, M. (2004). Animal Cell Culture and Technology.Taylor and Francis.Keywork USA.
- 7.Verma, A. S. and Singh, A. (2014).Animal Biotechnology. Academic Press, ELSEVIER, USA

Web Resources

- <https://www.britannica.com/science/tissue-culture>
https://en.wikipedia.org/wiki/Plant_tissue_culture
<https://microbeonline.com/animal-cell-culture-introduction-types-methods-applications/>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3	3				3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3	3				3	3	3	3
CO 4	2	3	3				3	3	3	3
CO5	2	3	3				3	3	3	3

S - Strong (3) M - Medium (2) L -Low(1)

SECOND YEAR: SEMESTER IV
CORE COURSE – VII: ENZYMOLOGY
SUBJECT CODE:T4BC7

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Externa I	Total
CC7	Core Course VII: ENZYMOLOGY	Core	3	1	-	-	4	4	25	75	100

Learning objectives

The main objectives of this course are to

- Provide fundamental knowledge on enzymes and their properties.
- Understand the mechanism of action of enzymes and the role of coenzymes in catalysis.
- Introduce the kinetics of enzymes and determine the K_m and V_{max} .
- Explain the effect of inhibitors on enzyme activity
- Understand the role of enzymes in clinical diagnosis and industries.

Module I : Introduction to enzymes :Nomenclature and Classification based on IUB with examples, enzyme as catalyst-Activation energy, Enzyme specificity-absolute, Group, linkage and stereo specificities. Concept of Active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity.12 Hrs

Module II :Mechanism of enzyme catalysis – Acid Base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effect. Coenzymes -Definition, types, co-enzymatic forms of vitamins- NAD/NADP,FAD, FMN, Coenzyme A TPP,PLP, lipoic acid and biotin. Multi enzyme complexes - Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH and CK.12 Hrs

Module III:Enzymekinetics --Definition of kinetics, Factors affecting enzyme activity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis-Menton equation for uni substrate reactions , Lineweaver - Burk plot, Eadie –Hofstee plot Significance of K_m and V_{max} and their determination using the plots.12 Hrs

Module IV: Enzyme inhibition - Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B plot,(Kinetic derivations not

required). Allosteric enzymes - Sigmoidal curve, positive and negative modulators 12 Hrs

Module V: Applications of enzymes -Immobilized enzymes - methods of immobilization-adsorption, covalent bonding, crosslinking, encapsulation, entrapment and applications of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes –Food, textile and pharmaceutical industries. 12Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Identify the major classes of enzymes, differentiate between a chemical catalyst and a biocatalyst and define the units of enzymes.	PO1
CO2	Explain the mechanism of enzyme catalysis and the role of coenzymes in enzyme action.	PO1,PO2
CO3	Illustrate the steady state kinetics, interpret MM plot and LBplot based on kinetics data, and determine Km and Vmax.	PO1,PO3
CO4	Distinguish the types of inhibition along with its importance in biochemical reactions.	PO1,PO3
CO5	Comprehend the various methods for production of immobilized enzymes and discuss the application of enzymes in clinical diagnosis and various industries.	PO1,PO2,PO6

Textbooks

- 1.U.Sathyanarayana&U.Chakrapani,2013,Biochemistry, 4th edition, Elsevier India Pvt. Ltd., Books& Allied Pvt. Ltd.
- 2.Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook of Biochemistry (Physiologicalchemistry), 18thedition, Goel Publishing House,
- 3.T.Devasena, 2010, Enzymology,1stedition, Oxford university Press.

Reference books

- 1.Trevor Palmer, 2008, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2ndedition, East West Press Pvt. Ltd.
- 2.David L.Nelson, Michael M.Cox, 2005, Principles of Biochemistry, 4thedition W.H. Freeman and Company.
3. Voet. D, Voet. J.G. and Pratt, C.W, 2004, Principles of Biochemistry, 4thedition John Wiley & Sons, Inc.

4. Zubay G.L,*et.al.*, 1995, Principles of Biochemistry, 1stedition, WmC. Brown Publishers.

Web resources

www.biologydiscussion.com/notes/enzymes-noteshttps://www.britannica.com/science/protein/The-mechanism-of-enzymatic-action<https://www.youtube.com/watch?v=oVJ2LJxO6tU>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3	2					3			3
CO 3	3		2				3			3
CO 4	3		2				3			3
CO 5	3	2				2	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

SECOND YEAR: SEMESTER IV

CORE COURSE – VIII: PRACTICAL-IV: ENZYMES

SUBJECT CODE:T4BC8

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
CC 8	CORE COURSE – VIII: PRACTICAL-IV: ENZYMES	Core	0	0	3	0	3	3	25	75	100

COURSE OBJECTIVES

- To demonstrate the enzyme kinetics experiments :-
- To Determine the factors affecting enzyme activity
- To determine the Km values of the enzymes
- To understand the Economical importance of enzymes

ENZYME KINETICS

1. Determination of total and specific activity of amylase.
2. Effect of pH on Amylase activity
3. Effect of temperature on Amylase activity .
4. Effect of substrate concentration on amylase activity and determination of Km value.
5. Effect of enzyme concentration on amylase activity.

DEMONSTRATION:

6. Effect of inhibitor on activity of amylase/urease.
7. Effect of activator on activity of amylase/urease.

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Determination of total and specific activity of amylase.	PO1,PO3
CO2	Effect of pH on Amylase activity	PO1,PO3
CO3	Effect of temperature on Amylase activity .	PO1,PO3
CO4	Effect of substrate concentration on amylase activity and determination of Km value.	PO1,PO3,PO6

1.U.Sathyanarayana&U.Chakrapani,2013,Biochemistry, 4th edition, Elsevier India Pvt. Ltd., Books& Allied Pvt. Ltd.

2.Dr. G.R Agarwal, Dr. Kiran Agarwal & O.P. Agarwal, 2015, Textbook of Biochemistry (Physiologicalchemistry), 18thedition, Goel Publishing House,

3.T.Devasena, 2010, Enzymology,1stedition, Oxford university Press.

Reference books

1.Trevor Palmer, 2008, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2ndedition, East West Press Pvt. Ltd.

2.David L.Nelson, Michael M.Cox, 2005, Principles of Biochemistry, 4thedition W.H. Freeman and Company.

3. Voet. D, Voet. J.G. and Pratt, C.W, 2004, Principles of Biochemistry, 4thedition John Wiley & Sons, Inc.

4. Zubay G.L,*et.al.*, 1995, Principles of Biochemistry, 1stedition, WmC. Brown Publishers.

Web resources

www.biologydiscussion.com/notes/enzymes-noteshttps://www.britannica.com/science/protein/The-mechanism-of-enzymatic-actionhttps://www.youtube.com/watch?v=oVJ2LJxO6tU

SECOND YEAR: SEMESTER IV

**MEDICAL CODING
SUBJECT CODE:T4BCSE6**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC6	Medical Coding	SEC(Discipline)	1	1	-	-	2	2	25	75	100

Course objectives

The objectives of this course are to

- Understand the basic concept of Medical coding
- Familiarize the student about medical terminology
- Understand about the classification of diseases based on WHO/AHA
- Understand about the CPT code used for diseases as per American Medical Association (AMA)

Module- I : Introduction to Medical coding, coding theory, Healthcare Common Procedure Coding, First Aid and CPR 6Hrs

Module- II: Introduction to Medical Terminology, specialization I & II, Diagnostic coding, factors affecting diagnostic coding 6Hrs

Module III: Documenting medical records- Importance of Documentation, Types of dictation formats 6Hrs

Module- IV :Introduction to Human Anatomy and Coding, ICD-10- CM classification system

6Hrs**Module- V** : Introduction to CPT coding, types of CPT coding Medical Law and Ethics6hrs

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Explaining the basic concept of coding and its application. Possess the knowledge about the First aid and CPR	PO1,PO2, PO6
CO2	Possess the knowledge about medical terminology used in Medical coding industry	PO1,PO2, PO6
CO3	Possess the knowledge about the ICD-10 CM international classification of diseases based on WHO	PO1,PO2, PO6
CO4	Possess the knowledge about the CPT codes used for diseases as per American Medical Association (AMA)	PO1,PO2, PO6
CO5	Understand CPT coding and its types	PO1,PO2, PO6

Text books

1. Understanding Medical Coding, A comprehensive guide Sandra L Johnson Robin Linker
2. Buck's Step – by – step Medical Coding Elsevier reference

Reference books

1. Terry Tropin M Shai, RHIA, CCS-P, AHIMA ICD-10-CM coding guidelines made easy 2017.
4. Besty J Shiland- Medical terminology and anatomy for ICD-10.

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3				3	3		2	3
CO 2	2	3				3	3		2	3
CO 3	2	3				3	3		2	3
CO 4	2	3				3	3		2	3
CO5	2	2				2	3		2	3

S - Strong (3) M - Medium (2) L -Low(1)

SECOND YEAR: SEMESTER IV

MICROBIAL TECHNIQUES SUBJECT CODE:T4BCSE7

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC7	SEC- Microbial techniques	SEC(Discipline)	1	1	-	-	2	2	25	75	100

Learning objectives

The objectives of this course are to

- Study the growth of bacteria
- Know the parts & uses of microscope
- Learn staining methods to identify microbes
- Learn different types of culture methods
- Study food preservation methods

Module – I: Growth of bacteria- Definition, growth phases, factors affecting growth (pH, temperature, and oxygen), cell count (hemocytometer, Bacterial cell- Bacillus subtilis), fungal cell (Saccharomyces) and human blood cell.6 Hrs

Module -II:Microscopy- Principle, types - Compound microscope, electron microscope- TEM, SEM, use of oil immersion objective.6 Hrs

Module III :Stains and staining- Principles of staining, simple staining, negative staining, Differential staining, Gram and acid-fast staining, flagella staining, capsule and endospore Staining. Staining of yeast (methylene blue), lactophenol cotton blue, staining of mold (Penicillium, Aspergillus), Agaricus.6 Hrs

Module IV:Cultivation of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), culture methods (streak plate, spread plate, pour plate, stab culture, slant culture, liquid shake culture, anaerobiosis) - aerobic and Anaerobic bacteria.6 Hrs

Module V:Food microbiology- Microbiological examination of food: microscopic examination and culture, phosphatase test of Pasteurized milk. Preservation of food- High temperature

(boiling, pasteurization, appreciation), low temperature (freezing), dehydration, osmotic pressure, chemical preservations, radiation. Microorganisms as food SCP.6 Hrs

Course Outcome

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Understand the growth of bacteria and to perform cell count	PO1,PO2
CO2	Acquire knowledge of microscope and its uses	PO1,PO2
CO3	Identify the microbes by staining methods	PO1,PO2, PO6
CO4	Culture microbes by various methods	PO1,PO2, PO6
CO5	Preserve foods at high and low temperature	PO,PO2, PO6

Text books

1. Sherris Medical Microbiology, 7th Edition by Authors: Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, Michael Lagunoff, Paul Pottinger, L. Barth Reller and Charles R. Sterling
2. Food Microbiology: Fundamentals And Frontiers, 5th Edition by Editor(s): Michael P. Doyle, Francisco Diez-Gonzalez, Colin Hill
3. Text book of microbiology by Ananthanarayan and Panicker's
4. Textbook of microbiology by P.C. Trivedi Sonali Pandey Seema Bhadauria
5. Prescott's Microbiology, 10th Edition by Authors: Joanne Willey, Linda Sherwood and Christopher J. Woolverton

Reference books

1. Bailey & Scott's Diagnostic Microbiology, 14th Edition by Author: Patricia Title
2. Medical Microbiology, 7th Edition Authors: Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller
3. Microbiology: Laboratory Theory and Application, 3rd Edition Authors: Michael J. Leboffe and Burton E. Pierce

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3				2	3	3	3	3
CO 4	2	3				2	3	3	3	3
CO5	2	3				2	3	3	3	3

S - Strong (3) M - Medium (2) L -Low(1)

THIRD YEAR: SEMESTER V

CORE COURSE – IX: CELL BIOLOGY

SUBJECT CODE:T5BC9

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC 9	Core Course IX: Cell Biology	Core	2	1	-	-	4	6	25	75	100

Learning Objectives

The main objectives of this course are to

- Provide basic understanding of architecture of cells and its organelles.
- Understand the organization of prokaryotic and eukaryotic genome.
- Educate on the structural organization of bio membrane and transport mechanism
- Impart knowledge on cell cycle, cell division and basics of cells
- Familiarize the concept of mechanism of cell-cell interactions.

Module I: Architecture of cells- Structural organization of prokaryotic and eukaryotic cells microbial, plant and animal cells. The ultrastructure of nucleus, mitochondria, RER, SER, golgi apparatus, lysosome, peroxisome and their functions 12 Hrs

Module II: Cytoskeleton- microfilament, microtubules and intermediary filament- structure, composition and functions. Organization of Genome -prokaryotic, and eukaryotic genome. Organization of chromatin – histones, nucleosomeconcept, formation of chromatin structure.Special types of chromosomes – lamp brush chromosomes, polytene chromosomes. 12 Hrs

Module III:Biomembranes-Structuralorganizationofbilipidlayermodelandbasicfunctions-transport across cell membranes- uniport, symport and antiport. Passive and active transport.12Hrs

Module IV: Cellcycle-DefinitionandPhasesofCellcycle-Celldivision-MitosisandMeiosis and its significance, Cancer cells- definition, types andcharacteristics of cancer cells. 12 Hrs

Module V: Extracellular matrix – Collagen, laminin, fibronectin and proteoglycans- structure and biological role. Structure and role of cadherin, selectins, integrins, Cell -cell interactions-Types-gap junctions, tight junctions and Desmosomes 12 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programo utcomes
CO1	Explain the structure and functions of basic components of prokaryotic and eukaryotic cells, especially the organelles.	PO1
CO2	Familiarize the cytoskeleton and chromatin	PO1,PO2
CO3	Illustrate the structure, composition and functions of cell membrane related to membrane transport	PO1,PO2
CO4	Elaborate the phases of cell cycle and cell division-mitosis and meiosis and characteristics of cancer cells.	PO1, PO2
CO5	Relate the structure and biological role of extracellular matrix in cellular interactions	PO1,PO2

Text books

- 1.Arumugam.N,Cellbiology.Saraspublication(10ed, paperback), 2019
2. Devasena.T.CellBiology.OxfordUniversityPressIndia-ISBN:9780198075516, 0198075510, 2012
- 3.Bruce Alberts and Dennis Bray. 2013, Essential Cell Biology. (4"ed). Garland Science.

Referencebooks

1. S.C,R.CellBiology.NewagePublishers -ISBN-10: 8122416888/ISBN-13: 978- 8122416886, 2008
- 2.Cooper,G.A.TheCell:AMolecularApproach.SinauerAssociates,Inc -ISBN10: 0878931066 / ISBN 13: 9780878931064, 2013
- 3...E.M.F.,D.R,CellandMolecularBiology.LippincottWilliams&WilkinsPhiladelphia - ISBN: 0781734932 9780781734936, 2006
4. LodishH.A ,Berk C.A, Kaiser M, Krieger M.P, Scott A, Bretscher H, Ploegh and Matsudaira. 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.

Web resources

- <https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf>
- <https://www.medicalnewstoday.com/article/320878.php>
- <https://biologydictionary.net /cell>

Mapping with Program Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3	3					3			3
CO 3	3	3					3			3
CO 4	3	3					3	3		3
CO5	3	3					3			3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR : SEMESTER V

CORE COURSE:X : INTERMEDIARY METABOLISM

SUBJECT CODE:T5BC10

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC10	Core course:X-Intermediary metabolism	Core	3	1	-	-	4	5	25	75	100

Learning Objectives

The main objectives of this course are to

- Review the basic concepts of free energy transformation and describe biological oxidation.
- Illustrate the pathways of carbohydrate metabolism.
- Explain the pathways of oxidation and biosynthesis of lipids.
- Detail the catabolism of amino acids and synthesis of specialized products from amino acids.
- Acquaint the metabolism of nucleic acids and its regulation

Module I : Bioenergetics-High energy compounds: Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP-ADP cycle.

Biological Oxidation: Electron transport chain -its organization and function. Inhibitors of ETC. Oxidative phosphorylation, P/O ratio, Peter Mitchell's chemiosmotic hypothesis. Mechanism of ATP synthesis, uncouplers of oxidative phosphorylation,substrate levelphosphorylationwithexamples.15 Hrs

Module II: Metabolism of carbohydrates -Glycolysis, TCA Cycle, Amphibolic nature and integrating role of TCA cycle. Anaplerosis, Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis and its regulation, glyoxylate cycle, Entner- Duodoroff pathway and Cori cycle.15 Hrs

Module III: Metabolism of lipids -Oxidation of fatty acids - α , β and ω -oxidation of saturated fatty acids, Oxidation of fatty acids with odd number of carbon atoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fattyacids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol. 15 Hrs

Module IV: Metabolism of amino acid- Metabolic nitrogen pool, Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination and decarboxylation, Biogenic amines, Urea cycle and its regulation.15 Hrs

Module V: Metabolism of nucleotides-Biosynthesis of purines and pyrimidines, - denovo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribonucleotide to deoxyribonucleotide 15 Hrs

Course Outcomes

	On completion of this course, students will be able to	Programo utcomes
	State the concepts of bioenergetics and illustrate the mechanism of flow of electrons and the production of ATP.	PO1,PO2
	Elaborate the biochemical reactions and integration of pathways of carbohydrate metabolism.	PO1,
	Sketch the oxidation and biosynthesis of fatty acids, phospholipids ,triglycerides and cholesterol with suitable examples	PO1
	Explain catabolism of amino acids, synthesis of non essential aminoacids and specialized products from aminoacids.	PO1
	Describe the metabolism of nucleic acids with necessary illustrations and its regulation.	PO1

Textbooks

- 1.U.Sathyannarayana &U.Chakrapani,2015,Biochemistry,4thElsevierIndiaPvt.Ltd.,
- 2.M.N. Chatterjea andRanaShinde,2002,
TextbookofMedicalBiochemistry,5theditionJaypeeBrothersMedicalPublishersPvt.Ltd.

Referencebooks

- 1.Lehninger PrinciplesofBiochemistry, David L. Nelson, Michael M.Cox, 2008, 5thedition, W.H.Freeman and Company.
- 2.Robert K.Murray,Daryl K.Granner,VictorW.Rodwell ,2006, Harper's Illustrated Biochemistry, 27thedition, McGraw Hill Publishers.
- 3.Principles ofBiochemistry Voet.D, Voet.J.G, and PrattC.W., 2010,, Fourth edition, John Wiley& Sons,Inc,.
- 4.Principles of Biochemistry, Zubay, William W. Parson, Dennis E.Vance,1995,2ndEdition,Wm.C. Brown Publishers.
- 5.Biochemistry, Garret, R.H.and Grisham,C.M. 2005,3rd Edition. Thomson Learning INC.

Web resources

1. <https://nptel.ac.in/courses/104/105/104105102/>

2. <http://www.nptelvideos.in/2012/11/biochemistry-i.html>

3. https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_ch15_metabolism_current-v2.0.pdf

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3	2					3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3						3			3
CO 5	3						3			3

S-Strong(3)

M-Medium (2)

L-Low (1)

THIRD YEAR: SEMESTER V

CORE COURSE:XI : MOLECULAR BIOLOGY

SUBJECT CODE:T5BC11

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC11	Core course XI Molecular Biology	Core	3	1	-	-	4	5	25	75	100

Learning Objectives

The objectives of this course are to

- Provide insights into the central dogma of molecular biology and explain the mechanism of DNA replication.
- Elaborate the mechanism of transcription and reverse transcription.
- Highlight the characteristics of genetic code and describe the process of protein synthesis.
- Introduce the concept of regulation of gene expression in prokaryotes
- Familiarize the different types of mutations and explain the mechanism of DNA repair.

Module I: Central Dogma of molecular Biology, DNA as the unit of inheritance. Experimental evidences by Griffith's transforming principle, Avery, McLeod and McCarthy's experiment, and Hershey and Chase Experiment. Replication in prokaryotes: Modes of replication, Meselson and Stahl's experimental proof for semi conservative replication. Mechanism of Replication – Initiation, events at Ori C, Elongation – replication fork, semi discontinuous replication, Okazaki fragments, and termination. Inhibitors of replication. 15

Hrs

Module II: Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications; inhibitors of transcription. RNA splicing and processing of mRNA, tRNA and rRNA. Reverse transcription. 15 Hrs

Module III: Genetic Code and its characteristics, Wobble hypothesis. Translation: Adaptor role

of t RNA, Activation of amino acids, Initiation, elongation and termination of protein synthesis, post-translational modifications and inhibitors of protein synthesis. 15 Hrs

Module IV: Regulation Of Gene Expression In Prokaryotes – Principles of gene regulation, negative and positive regulation, concept of operons ,regulatory proteins, activators, repressors, regulation of lac operon and trp operon.15 Hrs

Module V: Mutation: Types-Nutritional, Lethal, Conditional mutants. Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations.DNA repair: Direct repair, Photo reactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair . 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Illustrate the Central Dogma of molecular biology, explain the multiplication of DNA in the cell and describe the types and modes of replication.	PO1
CO2	Elaborate the mechanism of transcribing DNA into RNA, discuss the formation of different types of RNA.	PO1
CO3	Decipher the genetic code and summarize the process of translation.	PO1
CO4	Comprehend the principles of gene expression and explain the concept of operon in prokaryotes.	PO1,PO2
CO5	Distinguish the types of mutations and explain the various mechanisms of DNA repair.	PO1,PO2

Textbooks

- 1.Veer Bala Rastogi, 2008, Fundamentals of Molecular Biology, 1st edition,AnebooksIndia.
- 2.David Friefelder,1987, Molecular Biology, 2nd edition, Narosa PublishingHouse.
- 3.Dr.P.S.VermaandDr.V.K.Agarwal,2013,Cellbiology, Genetics, Molecular Biology, Evolution and Ecology,1stedition, S.Chand&Company Pvt. Ltd.

Referencebooks

- 1.Karp,G.,2010,Cell and Molecular Biology: Concepts and Experiments, 6thedition, JohnWiley & Sons. Inc.

2. De Robertis, E.D.P. and DeRobertis, E.M.F., 2010, Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins Philadelphia.

3. James. D. Watson, 2013, Molecular Biology of the Gene 7th edition, Benjamin Cummings.

4. George M. Malacinski, 1992, Freifelder's Essentials of Molecular Biology, 4th edition, Narosa publishing House.

Web resources

1. www.mednotes.net/notes/biology

2. <https://www.onlinebiologynotes.com/repair-mechanism-of-mutation/>

3. <https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3	2					3			3
CO 5	3	2					3	1		3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR: SEMESTER V

PRACTICAL XII

CELL BIOLOGY PRACTICAL

SUBJECT CODE:T5BC12

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC12	Core Course 12 practical V: Cell Biology Practical	Core practical	-	-	3	-	3	3	25	75	100

Learning Objectives

The main objectives of this course are to

- Learn the parts of microscope
- Image the cells using different stains
- Identify the cells, organelles and stages of cell division
- Identify the spotters

I MICROSCOPY AND STAINING TECHNIQUES

1. Study the parts of light and compound microscope
2. Preparation of Slides and Micrometry
3. Examination of prokaryotic and eukaryotic cell
4. Visualization of animal and plant cell by methylene blue
5. Visualization of nuclear fraction by acetocarmine stain
6. Staining and visualization of mitochondria by Janus green stain

II GROUP EXPERIMENT

7. Identification of different stages of mitosis in onion root tip
8. Identification of different stages of meiosis in onion bulb

III SPOTTERS

9. a) **Cells:** Nerve, plant and Animal cell
- b) **Organelles:** Mitochondria, Chloroplast, Endoplasmic reticulum,
- c) **Mitosis stages** – Prophase, Anaphase, Metaphase, Telophase

THIRD YEAR: SEMESTER V
BIOCHEMICAL PHARMACOLOGY
SUBJECT CODE: TBCECA

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC7	Elective Course IB Biochemical Pharmacology	Elective	3	1	-	-	4	5	25	75	100

Learning Objectives

The objectives of this course are to

- Introduce the basic concepts of pharmacology.
- Explain the metabolism of drugs and factors responsible for metabolism.
- Acquaint the adverse response and side effects of drugs .
- Familiarize important drugs used for common metabolic disorders.
- Provide an understanding about the action of antibiotics .

Module I: Drugs – classification based on sources, routes of drug administration - Oral/Enteral, Parenteral and Local application. Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs. 15 Hrs

Module II: Drug metabolism - Phase I and Phase II reactions, role of cytochrome P₄₅₀ , non-microsomal reactions of drug metabolism. Factors influencing drug metabolism. Therapeutic index. 15 Hrs

Module III: Drug allergy, Drug tolerance - IC 50, LD50 of a drug, Drug intolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance - biochemical mechanism. 15 Hrs

Module IV : Therapeutic Drugs - Analgesics and Non-steroidal anti-inflammatory drugs (NSAIDs) – Aspirin and Acetaminophen. Insulin, Oral antidiabetic drugs - Sulfonylureas, Biguanides. Antihypertensive drugs - ACE inhibitors, Calcium channel blockers. Anti-cancer agents – Antimetabolites. 15 Hrs

Module V: Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracyclines and chloramphenicol. 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Classify the different routes of drug administration, describe the absorption, distribution, metabolism and excretion of drugs.	PO1
CO2	Illustrate the metabolism of drugs, classify the microsomal and non-microsomal reactions and explain the role of cytochromes.	PO1
CO3	List out the various adverse response and side effects of drugs.	PO1,PO2,PO4
CO4	Justify the use of synthetic drugs and elucidate its pharmacological actions and its adverse effects for different disease.	PO1,PO4
CO5	Highlight the importance and explain the mode of action of important antibiotics.	PO1,PO4

Text Books

1. N.Murugesh, A concise text book of Pharmacology –Sathya Publishers.
2. Jayashree Ghosh, A Textbook of Pharmaceutical chemistry –S. Chand & Company Ltd.
3. S C Metha, Ashutosh Kar, Pharmaceutical Pharmacology –New Age International (P) Limited, Publishers.

References Books

1. Lippincott's illustrated Reviews- Pharmacology by Mary J.Mycek, Richard A.Harvey, Pamela C. Champe, Lippincott – Raven publishers, New Delhi.
2. David . E. Golan, Principles of Pharmacology, Wolters Kluwer (India) Pvt.Ltd.
3. R.S. Satoskar, S. B. Elsevier Pharmacology and pharmacotherapy. - ISBN-10 : 9788131248867 / ISBN-13 : 978-8131248867 ,2017.
4. Tripathi, K.Essentials of Medical Pharmacology. Jaypee Publishers- ISBN-10 : 9350259370 / ISBN-13 : 978-9350259375.2018.

Web Resources

<https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3	2		2			3	2		3
CO 4	3			2			3	2		3
CO 5	3			2			3	2		3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR SEMESTER V
BIOTECHNOLOGY
SUBJECT CODE:TBCECB

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext erna l	Total
EC8	Elective Course2 A - Biotechnology	Elective	2	1	0	0	3	5	25	75	100

Learning objectives

The main objectives of this course are to

- Impart knowledge on gene manipulation and gene transfer technologies
- Make the students understand the procedures involved in plant tissue culture.
- Acquire knowledge on animal cell culture and stem cell technology.
- Improve the employability skills of students by providing knowledge in recent techniques such as PCR, blotting, ELISA etc.
- Understand the application of fermentation technology.

Module I: Recombinant DNA technology

Recombinant DNA technology - Principles of gene cloning: restriction endonucleases and other enzymes used in manipulating DNA molecules. Ligation of DNA molecules, DNA ligase, linkers and adapters, homopolymer tailing, end labeling and construction maps of PBR322, λ bacteriophage. 15 Hrs

Module II: Plant Tissue culture

Plant tissue culture- basic requirements for culture, M S medium, callus culture, protoplast culture. Vectors – Ti plasmid (cointegration vector and binary vector), Viral vectors- TMV, CaMV and their applications. Transgenic plants – pest resistant, herbicide resistant and stress tolerant plants. 15 Hrs

Module III: Animal Tissue culture

Animal cell lines and organ culture - culture methods and applications. Transgenic animals: transgenic mice- Production and its applications. Stem cell technology: definition, types, and applications. 15 Hrs

Module IV: Molecular Techniques

PCR –Principle, types and its application in clinical diagnosis and forensic science. Southern blotting, Northern blotting and DNA finger printing Technique-principle and their applications. 15 Hrs

Module V: Fermentation technology

Fermentation technology – Fermentors - general design, fermentation processes - Media used, downstream processing. Production and applications of ethanol, Streptomycin and Proteases.Production of edible vaccines.15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programoutcomes
CO1	Acquire knowledge on rDNA technology, DNA manipulation, and use of restriction endonuclease	PO1,PO3
CO2	Get acquainted with the use of cloning and vectors in plant tissue culture.	PO1,PO2,PO3
CO3	Understand the methods for production of proteins using recombinant DNA technology and their applications, basics of tissue culture, transgenesis, stem cell technology, risks, and safety aspects and patenting in biotechnology	PO1,PO3
CO4	Gain knowledge about the importance of gene and gene manipulation technologies	PO1,PO3
CO5	Know the concept fermentation technology and its applications.	PO1,PO3

Text Books

1. James D. Watson , Amy A. Caudy , Richard M. Myers , Jan Witkowski (2006) Recombinant DNA: Genes and Genomes - a Short Course (3rd ed), W.H. Freeman & Co
2. Satyanarayana U (2008), Biotechnology, Books & Allied (P) Ltd.
3. Cassida L (2007) Industrial Microbiology , New Age International

Reference books

1. Reed G (2004) Prescott and Dunn's Industrial Microbiology, CBS Publishers & Distributors
2. Biotechnology: applying the genetic revolution- David P. Clark , Pazdernik N. J, Elsevier (2009).
3. Click B.R. and Pasternak J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed) American Society for Microbiology

Web Sources

NPTel Certification course - Gene Therapy by Sachin Kumar
<https://nptel.ac.in/courses/102/103/102103041/>

Coursera Certification course – Vaccines

<https://futureoflife.org/background/benefits-risks-biotechnology/>

<https://www.sciencedirect.com/topics/neuroscience/genetic-engineering>

[http://www.biologydiscussion.com/biotechnology/techniques-](http://www.biologydiscussion.com/biotechnology/techniques-biotechnology/important-techniques-of-biotechnology-3-techniques/15683)

[biotechnology/important-techniques-of-biotechnology-3-techniques/15683](http://www.biologydiscussion.com/biotechnology/important-techniques-of-biotechnology-3-techniques/15683)

<https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1>

https://www.slideshare.net/zeal_eagle/fermentation-technology

https://www.slideshare.net/zeal_eagle/fermentation-technology

<https://www.slideshare.net/Chepkitwai/blotting-techniques-6129300>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3		3	3	3	3	3	3
CO 2	3		3		3	3	3	3	3	3
CO 3	3		3		3	3	3	3	3	3
CO 4	3		3		3	3	3	3	3	3
CO5	3		3		3	3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Identify the parts of microscope.	PO1,PO2
CO2	Preparation of Slides	PO1,PO2
CO3	Identify the stages of mitosis & meiosis	PO1,PO2
CO4	Visualize nucleus and mitochondria by staining methods	PO1,PO2
CO5	Identify the spotters of cells,organelles and stages of cell division	PO1,PO2

Text books

- 1.Rickwood,DandJ.R.HarrisCellBiology: EssentialTechniques,Johnwikey1996.
2. Davis, J.M. Basic Cell culture: A practical approach, IRL 1994.
- 3.Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2ndEdn.

Reference books

- 1) Essential practical handbook of Cell biology ,Genetics and Microbiology -A Practical manual- Debarati Das Academic publishers, ISBN, 9789383420599, 1st Edition 2017
- 2) Cell biology Practical, Dr.Venugupta ISBN8193651219, Prestige publisher, 1st Jan 2018.
- 3) Cell and Molecular biology, DeRobertis, 8th edition, 1st June, 1987

Web resources

- 1.<http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1>
2. <https://www.microscopemaster.com/organelles.html>
3. <https://www.pdfdrive.com/biochemistry-books.htm>

4. http://medcell.med.yale.edu/histology/cell_lab.php#:~:text=The%20electron%20microscope%20is%20necessary,and%20small%20granules%20and%20vesicles.

5. <http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1>

6. <https://www.khanacademy.org/science/ap-biology/heredity/meiosis-and-geneticdiversity/a/phases-of-meiosis>

Mapping with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	2	3					3	3	3	3
CO 2	2	3					3	3	3	3
CO 3	2	3					3	3	3	3
CO 4	2	3					3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER VI

Core course XIII -CLINICAL BIOCHEMISTRY

SUBJECT CODE:T6BC13

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC13	Core course XIII Clinical Biochemistry	Core	3	1	-	-	4	5	25	75	100

Learning objectives

The main objectives of this course are to

- Comprehend the basic concepts and disorders of carbohydrate metabolism
- Explain the disorders of lipid metabolism.
- Elucidate the liver function test and kidney function test.
- Designate the gastric function test.
- Familiarize the clinical enzymology.

Module I :Disorders of carbohydrate metabolism: Maintenance of blood glucose by hormone with special reference to insulin and glucagon. Abnormalities in glucose metabolism: Diabetes mellitus; types, causes, biochemical manifestations, diagnosis and treatment, glycated hemoglobin. Inborn errors of carbohydrate metabolism, glycosuria, Fructosuria, Pentosuria, Galactosemia and Glycogen storage diseases.15 hrs

Module II: Disorders of Lipid Metabolism: Lipid Profile, Atherosclerosis, Fatty liver and hyperlipidemia. Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay-Sach's disease, Niemann-Pick disease, lipotropic agents 15 Hrs

Module III :Liver Function Tests: Bilirubin metabolism and jaundice, Estimation of conjugated and total bilirubin in serum (Diazomethod). Detection of bilirubin and bile salts in urine (Fouchet's test and Hay's Sulphur test). Thymol turbidity test, prothrombin time, serum enzymes in liver disease serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH). 15 Hrs

Kidney Function Tests: Measurement of urine pH, volume, specific gravity, osmolality,

sediments in urine, inulin, urea and creatinine clearance tests. Concentration and dilution tests. Phenol red test. Levels of plasma protein and its significance related to kidney function. Proteinuria. 15Hrs

Module IV :GastricFunction test:Composition of gastric juice, collection of gastric contents, examination of gastric residuum, fractional test meal (FTM), stimulation test- alcohol and histamine stimulation, Tubeless gastric analysis 1.5 Hrs

Module V:Clinical enzymology: Enzymes of diagnostic importance- LDH, creatine kinase, transaminases, phosphatases, Isoenzymes of lactate dehydrogenase. 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Explain the concepts of hormones and their importance to maintain glucose and types of Diabetes, diagnosis and treatment.	PO1,PO3,PO6
CO2	Analyze the lipid profile and different deficiency state.	PO1,PO3,PO6
CO3	Describe the liver and kidney functions and specific diagnostic methods used for biological sample.	PO1,PO3,PO6
CO4	Detail about the composition of gastric juice and special test for diagnosis.	PO1,PO3,PO6
CO5	Elaborate the enzyme markers used for diagnostic studies.	PO1,PO3,PO6

Text books

1. MN Chatterjee and Rana Shinde, TextBook of Medical Biochemistry, Jaypee Brothers Medical Publishers (P) LTD, New Delhi, 8th Edition, 2012
2. Ambika Shanmugam's Biochemistry for medical students, 8th edition, Published by Wolters Kluwer India Pvt. Ltd.

Reference books

1. Philip.D.Mayne, Clinical Chemistry in diagnosis and treatment. ELBS Publication, 6th edition, 1994.

2. Thomas M. Devlin (2014) Text book of Biochemistry with clinical correlations (7thed). John Wiley and sons.

3. Tietz Fundamentals of clinical chemistry and molecular Diagnostics (2014) (7thed) Saunders.

Web Resources

1. <https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-metabolism>

2. <https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests>

3. https://onlinecourses.nptel.ac.in/noc20_ge13/preview

Mapping with ProgramOutcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3		3			2	3	2	2	3
CO 2	3		3			2	3	2		3
CO 3	3		3			2	3	3	2	3
CO 4	3		3			2	3	3	2	3
CO 5	3		3			2	3	3	2	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER VI
Core course XIV-HUMAN PHYSIOLOGY
SUBJECT CODE:T6BC14

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC14	Core course XIV- Human Physiology	Core	3	1	-	-	4	5	25	75	100

Learning Objectives

The main objectives of this course are to

- Aid in understanding the physiology of respiratory and circulatory systems
- Explain the structure and physiology of the nervous and muscular system
- Explicate the functions of digestive and excretory system of the body.
- Impart knowledge about the process of reproduction.
- Emphasize the importance of various endocrine factors that regulate metabolism, growth, homeostasis and reproduction.

Module I: Respiratory System-Overview of respiratory system,Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues –Chloride Shift &Bohr’s effect, Lung surfactant. Circulatory System-Structure and functions of the Heart. Arterial and venous system,Cardiac cycle,Pace maker, Bloodpressure and Factors affecting blood pressure. 15Hrs

Module II: Nervous system- Structure of neuron, synaptic transmission, reflex action, neurotransmission- Resting membrane and Action potential. neuro transmitters- acetyl choline, Noradrenaline, Dopamine, Serotonin, Histamine, GABA, SubstanceP. Muscular system-structure and types of muscles - skeletal, smooth and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction. 15Hrs

Module III: Digestive system- composition, functions of saliva, gastric pancreatic intestine and bile secretions, structure of digestive system, Digestion, absorption of carbohydrates, lipids, proteins. Excretory system- Structure of nephron, mechanism of urine formation, Concentration and acidification of Urine. Role of kidneys in the maintenance of acid base balance. 15Hrs

Module IV: Reproductive system:-Oogenesis, spermatogenesis, capacitation and transport of sperm- blood testis barrier. Fertilization, early development, Implantation, Placentation and Parturition. 15Hrs

Module V: Endocrinology- Classification of hormones, endocrine glands and their secretions, structure and functions of Insulin, thyroxine. Steroid hormones- Corticosteroids, Sex hormones – testosterone and estrogen, menstrual cycle. 15Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Explain the exchange of gases, design of blood vessels and cardiac cycle.	PO1
CO2	Summarize the events in transmission of nerve impulses mechanism of muscle contraction.	PO1
CO3	Elaborate the structure and functions of digestive system, structure of nephron and mechanism of urine formation and role of kidney in maintenance of pH.	PO1
CO4	Describe the process of Oogenesis, Spermatogenesis, Fertilization, and Parturition.	PO1,PO2
CO5	Understand the role of different hormones that regulate metabolism, growth, glucose homeostasis and reproductive function.	PO1.PO2

Textbooks

1. K.Sembulingam & Prema Sembulingam, 2016, Essentials of Medical Physiology, 7th edition, Jaypee Brothers Medical Publishers(P)Ltd.
2. Chatterjee.C.C., 1988, Human Physiology- Vol II & II, 1st edition, Medical Allied Agency.
3. Animal Physiology- Mariakuttikanand Arumugam, Saras publication, 2017.

Referencebooks

1. Text book of medical biochemistry physiology- MN. Chatterjee and Rana shinde, 7th edition,

Jaypee brothers- medical publishers, 2007.

2. Meyer, Meyer & Meij, 2002, Human Physiology, 3rd edition, A.I.T.B.S Publishers.

3. Guyton and Hall, 2011, Textbook of Medical Physiology, 12th edition, W.B. Saunders Company.

4. Textbook of Medical Physiology – Guyton & Hall, 12th edition, Saunders Publishers, 2010

5. Human anatomy and physiology – Elaine N. Marieb, 3rd edition, Benjamin/Cummings (a Pearson education company), 1995.

Web resources

<https://www.youtube.com/watch?v=6qnSsV2syUE>

https://www.youtube.com/watch?v=9_h0ZXx1lFw

<https://slideplayer.com/slide/9431799/>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3	2		3
CO 2	3						3	2		3
CO 3	3						3	2		3
CO 4	3	3					3	2		3
CO5	3	3					3	2		3

S-Strong (3) M-Medium (2) L-Low (1)

Core course XV-CLINICAL ANALYSIS

SUBJECT CODE:T6BC15

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Ext ernal	Total
CC15	Core courseXV Practical V- Clinical analysis	Core Practi cal V	1	0	5	0	4	6	25	75	100

Learning Objectives

The objectives of this course are to

- Introduce the methods of sample collection (blood & urine) for analytical purpose.
- Impart practical knowledge on the assay of activity of various diagnostically important enzymes
- Understand the estimation procedure for various important biomolecules.
- Help students learn the routine qualitative analysis of urine sample for diagnostic purpose.
- Train students on various hematological tests and its significance.

1. Collection and preservation of blood and urine samples.

2. Estimation of creatinine by Jaffe's method (serum & urine)

3. Estimation of urea by diacetyl monoxime method (serum & urine)

4. Estimation of uric acid (serum & urine)

5. Estimation of cholesterol by Zak's method

6. Estimation of Glucose by Ortho Toluidine method

7. Estimation of Protein by Lowry's method

8. Estimation of Hemoglobin by Shali's/Drabkins method

9. Assay of SGPT and SGOT

10. Qualitative analysis of normal constituents of urine

Urea, Creatinine, Phosphorus, Calcium

Abnormal constituents

a) Calcium

b) Sugar (Glucose, fructose, pentose)

c) Protein

d) Amino acids (Tyrosine, Histidine, Tryptophan)

e) Ketone bodies

f) Bile pigments with clinical significance. 80 Hrs

DEMONSTRATION EXPERIMENTS (10 Hrs)

HEMATOLOGY

- a. RBC Counting
- b. Total and differential count of white blood cells
- c. Packed cell volume
- d. Erythrocyte sedimentation rate
- e. Blood clotting time
- f. Blood grouping

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Acquaint knowledge on collection of biological samples (urine, blood) and their preparation for diagnostic purpose.	PO1, PO2
CO2	Assay the activity of various clinically important enzymes and relate their clinical importance.	PO1, PO2
CO3	Estimate the important biomolecules in biological samples and relate their clinical significance	PO1, PO2, PO3, PO6

CO4	Qualitatively analyze urine sample for normal and abnormal constituents in urine and interpret the results	PO1,PO2,PO3
CO5	Perform the routine haematological tests.	PO1,PO2,PO3,PO6

Text Books

1. Manickam, S.S. (2018). Biochemical Methods (3rd ed.). New Age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408
2. Plummer, D.T. (n.d.). An Introduction to Practical Biochemistry. Tata McGraw Hill - ISBN: 97800708416
3. Alan H Gowenlock. 1998. Varley's Practical Clinical Biochemistry, 6th edition, CBS Publishers, India.
4. B. Godkar. 2020. Textbook of Medical Laboratory Technology Vol 1 & 2 Paperback, 3rd edition, Bhalani Publishers.
5. Kanai L Mukerjee. 1996. Medical Lab Technology, Vol I & II, 1st edition, Tata McGraw Hill, Pennsylvania.
6. Ranjna Chawla. 2014. Practical Clinical Biochemistry Methods and Interpretations 58 (Paperback). 4th edition, Jaypee Brothers Medical Publishers, New York.

Reference books

1. Singh, S.K. (2005). Introductory Practical Biochemistry (2nd ed.). Alpha Science International, Ltd - ISBN 10: 8173193029 / ISBN 13: 9788173193026
2. Ashwood, B. A. (2001). Tietz Fundamentals of Clinical Chemistry. WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 978072168634

Web resources

1. <https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors>
2. <http://rajswashya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf>

3.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistry.pdf?sequence=1&isAllowed=y

4.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistry.pdf?sequence=1&isAllowed=y *

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3	3					3	3	3	3
CO 2	3	3					3	3	3	3
CO 3	3	3	3			3	3	3	3	3
CO 4	3	3	2				3	3	3	3
CO 5	3	3	3			3	3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR : SEMESTER VI

Elective Course IX – IMMUNOLOGY

SUBJECT CODE:TBCECC

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC 9	Elective Course IX Immunology	Elective	3	1	-	-	4	5	25	75	100

Learning Objectives

The objective of this course are to

- Introduce the structure and functions of lymphoid organs and cells of the immune system
- Illustrate the structure and classification of antibodies and adaptive immune response
- Impart knowledge on the types of immunity and uses of vaccines
- Provide an understanding of immune related diseases and transplantation
- Study the Ag-Ab interaction and immunological techniques to identify antigens and antibodies

Module I :Structure and function of primary lymphoid organs (thymus ,bone marrow), secondary lymphoid organs (spleen, lymph node), Cells involved in immune system-Functions-Phagocytosis -Inflammation 15 Hrs

Module II: Antigens - Nature, Immunogens, haptens ,cross reactions - Immunoglobulin- types- structure and function. Cells involved in antibody formation, Clonal selection theory, Co-operation of T-cell with B-cell. Differentiation of T and B lymphocyte -Humoral and cell mediated immunity. Monoclonal antibody – Production and application in biology. 15Hrs

Module III- Immunity and its types-Innate, Acquired, active and passive.- Natural and Artificial - Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA Vaccines, DNA and subunit vaccines 15Hrs

Module IV: Hypersensitivity – Immediate (Type 1) and Delayed (Type IV), Auto- immune diseases with examples. Organ specific and systemic autoimmunity. SLE, RA. Transplantation – Types of Grafts, structure& functions of MHC, graft Vs host reaction, immunosuppressive Agents. 15Hrs

Module V: Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immuno diffusion, SID and DID - Oudin Procedure, Oakley Fulthrope Procedure, Radio immunodiffusion, Ouchterlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA. 15Hr

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Associate structure and function of the organs involved in our body's natural Defence	PO1
CO2	Classify antigens and antibodies and the role of lymphocytes in defending the host	PO1,PO2
CO3	Describe the types of immunity and the uses of vaccines	PO1, PO4
CO4	Understand the immune related diseases and mechanism of transplantation	PO1,PO2
CO5	Examine the immunological tests and relate it to the immune status of an Individual	PO1,PO3

Text Books

- 1.Kuby, J. (2018). Immunology(5th ed). W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701
2. Rao, C. V. (2017). Immunology (3rd ed.). Chennai: Alpha Science Int. Ltd - ISBN-10 : 1842652559/ ISBN 13:978-1842652558
- 3.Tizard(1995). An Introduction to Immunology. Harcourt Brace College Publications

References Books

- 1.Kenneth M. Murphy, Paul Travers, Mark Walport - (2007), Janeway's Immunobiology, 7thedition, Garland Science.
2. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober - (1994), Cellular and molecular immunology, 2ndedition, B. Saunders Company.
3. Basic Immunology Functions and Disorders of the Immune System, 6th Edition - January 25, 2019 Authors: Abul Abbas, Andrew Lichtman, Shiv Pillai, ISBN: 9780323549431eBook ISBN: 9780323639095
4. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - (2006),Roitt's Essential Immunology, 11th edition, Wiley-Blackwell

Web resources

1. https://onlinecourses.nptel.ac.in/noc22_bt40/preview
2. https://onlinecourses.swayam2.ac.in/cec20_bt05/preview
3. <https://youtu.be/8uahFPI6ny8>

Mapping with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3		2				3			3
CO 3	3			2			3	3		3
CO 4	3	2					3	1		3
CO 5	3		3				3	3	3	3

S-Strong(3) M-Medium (2) L-Low (1)

THIRD YEAR :SEMESTER VI

Elective Course X -RESEARCH METHODOLOGY

SUBJECT CODE:TBCECD

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC10	Elective Course X Research Methodology	Elective	3	1	-	-	4	5	25	75	100

Learning objectives

The objectives of the course are to:

- Introduce the components of research.
- Acquaint on the experimental design and literature survey
- Analyse the data and find out the significance statistically
- Highlight the importance of computation in research.
- Provide mechanics of writing a research report hands-on experience in designing and working on small projects.

Module I: Characteristics and types of Research, Research Methods versus Methodology, Research designs in Biochemistry: experimental, *in vitro*, *in vivo*, *in situ*, clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components. 15 Hrs

Module II: Experimental design - Objective, Design of work, Guidelines for design of experiments, Literature Search - Databases for literature search, Material and methods, Designing biological experiments, Compilation and documentation of data 15 Hrs

Module III : Statistical Analysis: Measures of variation - standard deviation, Non-linear regression, Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students "t" test, chi-square test. Dunnet's test 15Hrs

Module IV: Computer and its role in research: Basics of MS word, MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Use of statistical software SPSS. Power Point: preparation of presentations and scientific poster designing

15 hrs.

Module V: Scientific writing for journals - Preparation of Abstract, Impact factor, h-index, i-10 index, citation index, Dissertation/Thesis writing: format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Writing results, discussion and conclusions. Bibliography and references, referencing style - Harvard and Vancouver systems, Appendices and acknowledgement; Ethical issues in research; Intellectual property right and plagiarism. 15 Hrs

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Explain the types of research and formulate and plan the research.	PO1,PO3
CO2	Design experimental setup, review the literature, compile and document the data.	PO1,PO3
CO3	Analyze and validate the experimental data using statistical tools	PO1,PO2,PO3
CO4	Interpret the data using computational tools.	PO1,PO2,PO3
CO5	Compile and draft a research report, present results findings and publish ethically.	PO1,PO3,PO4

Text Books

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., Research Methodology: Methods and Techniques. 2004, New Age International.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
4. Gurumani.N, Research Methodology for biological Sciences, 2014, MJP Publishers.

Reference Books

1. Dr. Prabhat Pandey ,Dr.Meenu Mishra Pandey, Research Methodology: Tools and Techniques 2015
- 2.Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6. Scientific Thesis Writing and Paper Presentation . MJP Publishers.2010
7. Research Methodology (2 Vols-Set) ,Suresh C. Sinha and Anil K. Dhiman, Vedams Books (P) Ltd.2002.

Web Resources

1. <https://explorable.com/research-methodology>
2. <http://www.scribbr.com>